THERMOTRON INDUSTRIES

Holland, Michigan

INSTRUCTION MANUAL

- For -

THERMOTRON ENVIRONMENTAL CHAMBER

Temperature - Vibration

Model F-42-CHV-LN_2

Serial No. 22-9255

- Manufactured For -

TELEDYNE SYSTEMS

19601 NORDHOFF STREET

NORTHRIDGE, CALIFORNIA

Purchase Order No. 20330

THE THERMOTRON INSTRUCTION MANUAL

Thermotron instruction manuals are dedicated to assisting the reader-user toward a better understanding of Thermotron Environmental Chambers and associated equipment. Most instruction manuals are seldom read except in the time of crisis when equipment malfunction is suspected. When this happens, the manual is usually missing, or at best, difficult to locate. So to start things off on the right foot, WHY NOT FIND A CONVENIENT SPOT TO KEEP THIS MANUAL?

We at Thermotron have tried to produce a usable manual. But being human, we are subject to frailties of behavior. Therefore, should you discover any errors or omissions, or should you wish to contribute any recommendations, send us your comments. We at Thermotron will be most appreciative.

WARNING

PRODUCT PROTECTION

When operating this chamber with a live load (heat dissipating product) or a dead load, auxiliary protection should be provided by the operator (customer). Provision must be made to remove power from the product on test and the chamber in the event the chamber temperature exceeds a predetermined safe limit for the product within the chamber.

Thermotron chambers are equipped with high heat limit, or safety devices. These safety devices are installed to protect the chamber from exceeding design limits. These safety devices remove power ONLY from the chamber heaters and DO NOT remove power from your product; therefore, a device such as the THERMOTRON PRODUCTSAVER, or equivalent, must be used to remove power from the product and the chamber should an "out of tolerance" condition occur.

The PRODUCTSAVER is designed with concealed setpoints for high and low temperatures. These can be precisely set at a temperature limit to permit safe operations. Power to the product and a circuit interrupting power to the chamber must both be wired through the output relays of the PRODUCTSAVER. The PRODUCTSAVER will then shut down chamber operation and product operation within the safe operating temperature limits of the product, either hot or cold.

THERMOTRON

PRODUCT SAVER (TM) TEMPERATURE LIMIT CONTROL AND ALARM SYSTEM MODEL 012005

Thermotron Industries
Automatic Control Systems Division
Kollen Park Drive
Holland, Michigan 49423 U.S.A.
Phone (616) 392-1492 T.W.X. 810-292-6264

- **Positive open sensor detection for product protection**
- **Visual and audible alarms with contact closures for individual alarm system**
- **Establishes *both* high and low temperature limits**
- **Selectable operating characteristics provide manual or automatic reset**
- **Tamper-resistant set point adjustments for your protection**
- **High electrical noise immunity for heavy industrial applications**
- **Fully solid state for increased reliability**

General Description

The Productsaver(TM) is an indispensable, bi-directional temperature limit alarm system to protect product and process or both from high and low temperatures. It is designed for applications where temperature must be maintained within prescribed limits and where extreme temperature conditions can damage the process or equipment.

Specifications — 012005

Input:
Thermocouples, type T, J, K, R, SB. Not affected by thermocouple resistances of up to 1000 Ohms. Must be specified when ordering.

Range:
Many standard ranges immediately available, optional ranges can be specified.

Measuring/Alarm Accuracy:
± ¼% typical.

Outputs:
Visual — Separate alarm (yellow), 'high limit' (red) and 'low limit' (green) warning lights. **Audible —** Pulsing 2800 Hz, 70 db warning tone. **Contacts —** Separate 'alarm', 'high limit' and 'low limit' SPDT contacts, rated 4A @ 115vac.

Sensor Break/Failsafe Protection:
Special circuit provides full-scale temperature indication, turns on 'alarm' light and turns off 'high' and 'low' limit contacts.

Cold Junction Compensation:
Precision oven type stabilization.

Alarm Set Points:
Screwdriver-adjustable high-resolution (±0.2%) potentiometers. Adjustable from front panel.

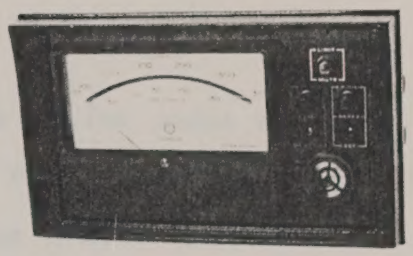
Indication:
6" (15.4cm) meter displays temperature, or set point levels when 'high' or 'low' pushbuttons are depressed at front panel.

Alarm Repeatability:
±0.1%.

Hysteresis:
Less than ±0.05%.

Operable Ambient Range:
+32F to +131F (0C to +55C).

Temperature Effect:
Less than ±0.01%/deg F. (from 77F) (±0.02%/°C) over operating range.



Power Requirements:
117vac 50/60 hz.

Line Voltage Effect:
Less than ±0.03% for ±15% line voltage changes within operating range.

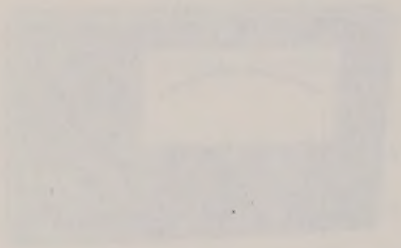
Housing:
Panel mounting aluminum case, suitable for bench service.

Connectors:
Screw type barrier strips.

Dimensions:
5.8" (14.73cm) high, 9.6" (24.38cm) wide and 8.4" (21.34cm) deep. Protrudes 7.2" (18.29cm) behind mounting panels.

Weight:
6.5 lbs (2.95kg).

Form No. CS1-006-481 Printed in U.S.A.



SPARE PARTS and RETURN OF MATERIALS

SPARE PARTS:

Thermotron recommends that its customers maintain a minimum quantity of spare parts. These parts are essential to the proper care and maintenance of your equipment, which minimize costly down time. We strive to maintain an adequate parts inventory and will be pleased to serve you if we can.

RETURN OF MATERIALS:

In the event that you have a part that has failed under warranty, or a part which requires repair, call the Parts and Logistics Department at Thermotron. At this point an R.M.T. (Returned Material Tag) number will be issued, and authorization for the return of the item will be given to you. This number should be marked boldly on the outside of your package as well as recorded on your packing slip. When ordering the replacement part, the following information is required:

A. The complete part number.
B. The serial number of the corresponding Thermotron test unit.
C. The specific complaint regarding part failure.
D. A Purchase Order number is preferred, and in many cases required.

A telephone number and contact person should be listed on your packing slip so that we know who to contact in case of a question.

For warranty replacement parts, you will be invoiced upon the date of shipment and will be issued credit on that invoice upon

our receipt of the defective item. IT IS IMPORTANT THAT YOU IDENTIFY THE ITEM WITH THE R.M.T. NUMBER THAT IS ASSIGNED.

All parts are shipped F.O.B. Holland, MI.

Parts and Logistics Department

Phone: (616) 392-1491

Night Phone: (616) 392-1498

RECOMMENDED SPARE PARTS LIST

Part No.	Computer No.	Nomenclature	Qty Per Chamber
42BE25AF	570874	Contactor, Power	1
235N0-120A	571234	Contactor, Hg	1
319B003Q1C	563169	Timer, Delay	1
EL1134-26	545320	Heater, Open Coil	1
678200	554270	Motor, Circulator	1
151008	151008	Thermocouple	1
7500K14	565765	Switch	1
1050QA1	566109	Lamp, Neon	1
F10H07	603139	Blade, Fan	1
WUY	534010	Link, Heat	4
75PAR38	556308	Bulb	1
151007	151007	Thermocouple	1
42BE35AF	500096	Contactor, Power	1
7560K5	565773	Switch, Toggle	1
D2410	555735	Relay, Solid State	1
HT-8263-A210LT	549220	Solenoid, LN_2	1
8263-B206LT	549212	Solenoid, LN_2	1

INDEX

SECTION	DESCRIPTION
	DATA SUMMARY SHEET
1	GENERAL DESCRIPTION
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3	COOLING
4	ELECTRICAL
5	PROTECTIVE OR SAFETY DEVICES
6	OPERATING INSTRUCTIONS
7	PREVENTIVE MAINTENANCE
8	HUMIDIFICATION-DEHUMIDIFICATION
9	PNEUMATIC SYSTEM
10	VACUUM SYSTEM

DATA SUMMARY SHEET

Model: F-42-CHV-LN_2

The model number defines the basic chamber.

F - Front door opening

42 - 42 cubic feet of test space

C - Cooling

H - Heating

V - Vibration ("AGREE" type, designed to be compatible with a vibration machine.)

LN_2 - LN_2 is injected into the chamber to accomplish the cooling.

TEMPERATURE RANGE: -100°F to +350°F (-73.3°C to +177°C)

TEMPERATURE TOLERANCE:

Through the specified range, the temperature stability shall not exceed plus or minus 1.1°C (2°F) about the control point.

TEMPERATURE PERFORMANCE:

The chamber, (with shaker equipped with an insulated top) with LN_2 cooling, is capable of performing AGREE MIL-STD 781A and B Test Levels A through E, with 500 pounds of aluminum, Test Levels A through F with 400 pounds of aluminum, Test Levels A through J with 300 pounds of aluminum, and similar Mil-Specifications which require an average temperature change of 5°C per minute.

VOLTAGE: 208/3/60 RATED FULL LOAD: 55.7

DATA SUMMARY SHEET

INSTRUMENTATION:

Make: Thermotron Controller*

Model: 012003

Make: Thermotron Indicator/Set Point Assembly*

Model: 013005

Make: Thermotron Slope Generator*

Model: 013008/9

Make: Thermotron Productsaver

Model: 012005

Make: Thermotron Set Point Selector Switch

Model: o48029

*Note: Use of these components, and the LN_2 circuit interrupter INF-120-8B, is dependent upon the additional protection afforded by the ground fault circuit interrupter and the overcurrent protective device provided. DO NOT remove or defeat these protective devices.

GENERAL DESCRIPTION

This manual is provided to acquaint the operator with Thermotron equipment. The enclosed schematics will enable an understanding of how the various conditions and control functions are achieved. Thermotron engineering and "know how" are built into each assembly of environmental test equipment. This assures dependable operation of specific functional tests. Minimum maintenance will be achieved through periodic checks and proper care.

This chamber is completely self-contained and interconnected, capable of producing and maintaining the environmental conditions outlined. The materials, component parts, mechanical assemblies and workmanship used in the contruction of this chamber are of the best commercial quality. All protective features normally incorporated in electrical and mechanical apparatus of this type have been used. The system is completely safety interlocked to prevent damage to the chamber in case of failure of any part.

EXTREME TEMPERATUPE WARNING

This equipment is designed to operate at extreme high and low temperatures. Care should be taken to prevent exposure (opening the door or putting a hand through a port) at temperatures other than near ambient.

GENERAL DESCRIPTION

POWER:

The chamber is designed to operate on the specific service supplied by the customer. The source of power necessary for the operation of the chamber terminates at the main power terminal block located inside the electrical compartment.

All of the major components requiring large amounts of current are operated from the main power source. Each circuit has its branch circuit protection. The control circuit operates on 115 volts. (Refer to electrical schematic.)

Control function switches, equipped with neon indicating lights, are readily accessible, providing a means of selecting the desired operating conditions.

All electrical components, whenever possible, are contained in a separate panel. All wiring is identified and either laced or enclosed in conduit. All circuits are protected with heat links or fuses. Electrical system meets N.E.M.A. standards.

HIGH VOLTAGE WARNING

This equipment is supplied with a high voltage power source and should be serviced or adjusted only by qualified personnel.

GENERAL DESCRIPTION

AIR CIRCULATION:

Thermotron utilizes propeller-type fans to provide the necessary air circulation within the chamber test space. The circulation fans are located clear of the test space. This location permits diffused air flow. Each fan is driven by an externally located ball bearing motor. A specially machined stainless steel motor shaft directly drives the circulator fan. There are no bearings within the test space. (The bearings of the electric motor are life lubricated and require no lubrication.) The conditioned air is directed to a baffle, which distributes it evenly throughout the chamber.

3-PHASE FAN MOTORS:

The direction of rotation should be checked periodically to make certain of proper rotation. This is very important in respect to control gradients, and capacity rates of the chamber. Normally, direction of rotation can be assumed correct if the air is discharged over the instrument control sensor.

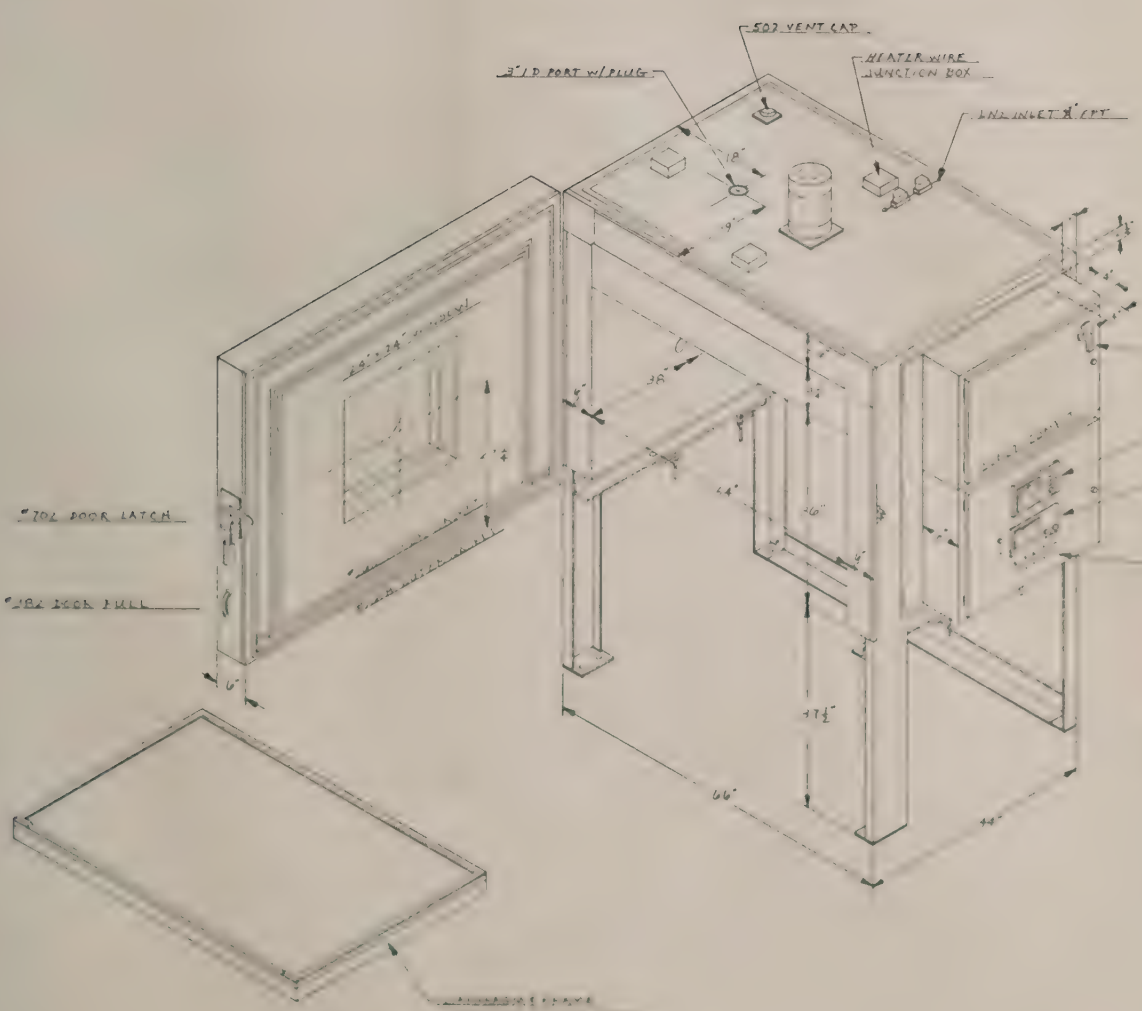
CIRCULATOR FAN WARNING

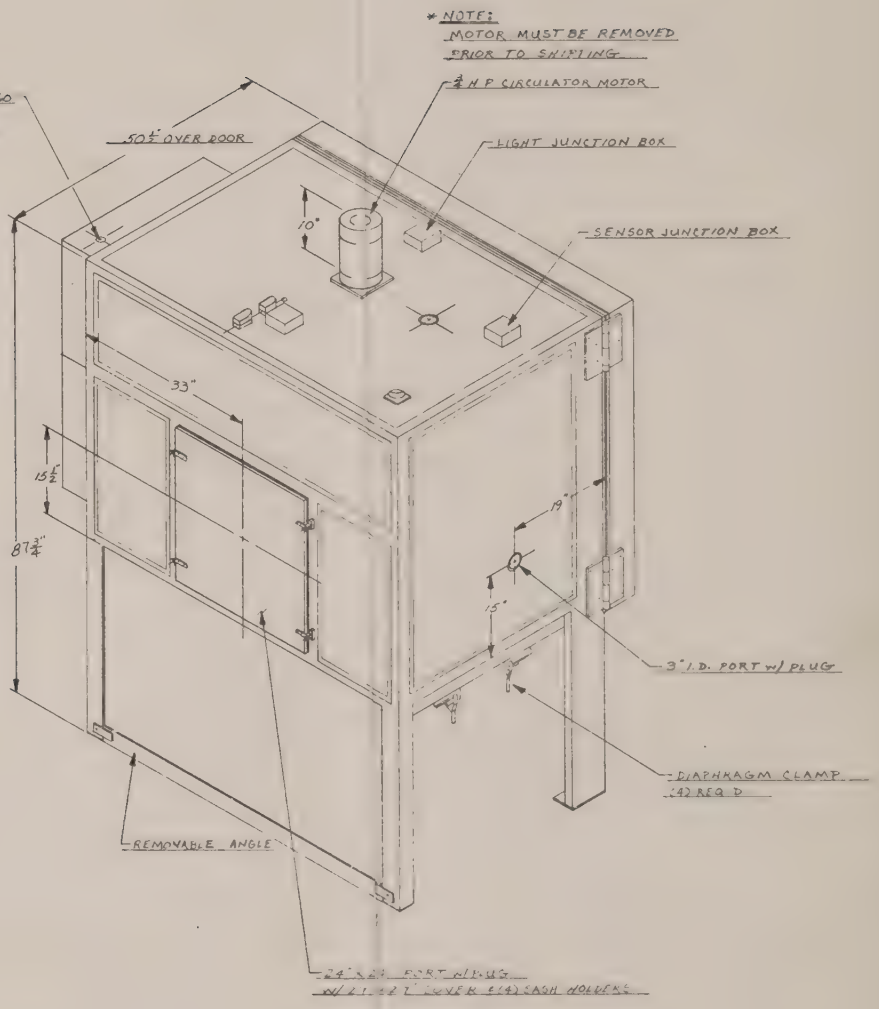
The circulator switch should be OFF any time the chamber door is open. The circulator fan could be a potential hazard to anyone working near it.

GENERAL DESCRIPTION

GLOVE PORTS: (Optional)

Gloves must not be left in chamber when the operating chamber temperature exceeds +150°F (+65.6°C).


SO2 VENT CAP
HEATER WIRE JUNCTION BOX
3" I.D. PORT w/PLUG
LN2 INLET & EXT
18"
9"
38"
44"
46"
66"
44"
6"



NER
ECT SWITCH

GAUGE

GENERATOR W/
M SWITCH &
ELECTION SWITCH

ON SWITCHES

I COMP'T &
UMLNI COMP'T
BE BOLTED ON

THERMOTRON CORPORATION					
AND, MICHIGAN 49423				DRAWN BY	DRAWING NO. 077-7255

INSTALLATION INSTRUCTIONS

LOCATING INSTRUCTIONS FOR AGREE CHAMBERS:

In order to effect an installation that will be permanently satisfactory, "AGREE"-type test chambers should be securely fastened to the floor.

Over a period of time, temperature cycling within the chamber, combined with the effects of ambient vibration and temperature variations, can move the chamber out of its original position. This can stress plumbing and conduit connections, and may result in misalignment of the vibration test machine and chamber door.

Tie-down positions are provided on each chamber support leg. These tie-down points are also used for shipping. Note their position prior to removing the chamber from its shipping platform. The best method of lagging the chamber to the floor should be determinded prior to locating the unit.

1. Locate the chamber on a solid, level foundation. Shim base of equipment as necessary to achieve this. In moving or relocating the equipment, never tip more than 45 degrees without special instructions from the manufacturer.
2. Secure the chamber to the floor in the sequence noted in the following steps, which also contain door alignment procedures.
   A. Secure the rear legs of the chamber to the floor.
   B. Use a step jack to raise the latch side of the door until it is approximately 1/8" higher than the body of the chamber. This will properly position the leg on the hinge side of the door.

INSTALLATION INSTRUCTIONS

LOCATING INSTRUCTIONS FOR AGREE CHAMBERS: (Continued)

C. Secure the hinge side leg to the floor.

D. Install the diaphragm or floor plug. Move the leg on the latch side of the chamber to attain the proper clearance between the diaphragm or floor plug and the diaphragm rails.

E. Secure the leg on the latch side of the chamber to the floor. With the chamber securely anchored, the door should be checked for proper closing and operation.

INSTALLATION INSTRUCTIONS

ELECTRICAL:

Refer to electrical schematic and provide proper power supply to the main disconnect switch.

Connect to terminals as indicated and check rotation of circulator motor for correct fan rotation.

INSTALLATION INSTRUCTIONS

LOCATING INSTRUCTIONS FOR L.A.B. SHAKERS:

The vibration test machine is to be located within the chamber test space in such a manner that the top surface of its table will be geometrically centered with respect to the side walls of the chamber.

A flexible diaphragm is provided with the chamber which will mate with the table of the vibration test machine and a special rack on the chamber. This diaphragm provides a hermetic seal around the edges of the vibration table. Optional brackets are available to offer a means of supporting the diaphragm assembly when the vibration test machine is outside the chamber (during test set-up, etc.).

The vibration test machine is properly oriented when its two torsion bar adjustment studs face outward from the test chamber. (These studs are located on the lower front panel of the machine's base, one on either side.) The manual electrical control box and power cord will then be on the right-hand side of the machine for convenient access to the shaker receptacle on the chamber. Two of the wheels on the machine are equipped with locking screws; these screws should also be located on the front side of the unit to insure accessibility.

The wheels of the vibration test machine are V-grooved to mate with a special steel track which is usually provided with each unit (tracks are optional from L.A.B.). These tracks provide a means of easily moving the vibration test machine into and out of the chamber without having to recenter the unit each time it is reinstalled. If the tracks are to serve their intended purpose, they must be fastened to the floor securely. Two pieces of angle iron, $\frac{1}{2}$" x $\frac{1}{2}$" x 3", may be fastened on the top and towards the rear of both tracks in order to provide a back-stop for the vibration test machine when it is rolled into the chamber.

For best results mark the proper position for the track with the vibration test machine and the diaphragm assembly properly located within the chamber. If the back-stops are to be included, locate them behind the rear wheels (tight against the wheels) of the vibration test machine and also mark their position at this time.

INSTALLATION INSTRUCTIONS

DIAPHRAGM:

The Thermotron "AGREE" chamber is used to perform combined temperature and vibration test programs. The vibration port (open bottom) is built to accept a diaphragm and frame. The diaphragm material is silicone impregnated fiberglas. The silicone diaphragm is sized with enough edge material to allow free movement of the shaker head. The diaphragm is flexible under all temperature conditions. The diaphragm closes the entire bottom of the chamber, wall to wall, and across the top of the vibration machine. The diaphragm and frame are easily removed from the chamber. On removal, the vibration machine carries the diaphragm and retainer frame with it. This allows you to remove the shaker and its product load without raising or lowering the chamber.

It is suggested that an insulating spacer panel (1½" thick) be placed on the shaker head to minimize thermal transfer between the vibration machine and the test compartment.

INSTALLATION INSTRUCTIONS

LN_2 COOLING

Connect a clean, dry supply of LN_2 at 30 P.S.I. to the inlet side of the LN_2 control solenoid valve. (Insulate the piping from the supply to the chamber LN_2 valve).

NOTE: A high pressure relief valve should be connected to this line to relieve pressure if LN_2 is trapped in the line.

Connect an LN_2 vent exhaust line (of the same size diameter as vent) to the vent connection provided. The line should be as short as practical and with as few bends as possible, to prevent back pressure.

START-UP PROCEDURE

In the event that this system is to be started up by non-Thermotron personnel, it is important that those performing the start-up be experienced in electrical and LN_2 cooling. The following instructions will assist in starting up the equipment.

ELECTRICAL:

1. Verify that the input line power is the same as is called out on the electrical schematic.
2. With the power OFF, open the electrical panel and verify that there are no loose connections. Verify also that there are no damaged contactors, relays, or timers (cracked, burned, etc.).

"SYSTEM ON" PROCEDURES: (Have an amprobe ready.)

NOTE: Prior to attempting to perform the "SYSTEM ON" procedures, it is strongly recommended that the individual(s) performing the start-up carefully study all component literature, and the operating instructions in Section 6 of this manual.

1. Verify that all function switches are in the OFF position.
2. Turn the MAIN DISCONNECT switch ON.
3. Turn the PILOT switch ON, and verify that it is operational.
4. Turn the LIGHT switch ON, and verify that it is operational.
5. Turn the CIRCULATOR switch ON.
   A. Visually verify that the circulator motor is running.
   B. With an amprobe, check circulator current.

      NOTE: Carefully check all three legs of three phase circulators. If one leg is drawing excessively higher amperage than the others, you may be on the verge of single phasing and burning out the motor.

START UP PROCEDURE

"SYSTEM ON" PROCEDURES: (Continued)

5.

C. When the circulator motor is three phase, check for proper air flow directions. On squirrel cage type fans (blower wheels), this can be checked by turning the circulator OFF, and noting the direction of rotation of the blower wheels as they slow. The louvers must be angled away from the direction of rotation. When fan blades are utilized, verify that the air is being discharged over the instrument control sensor. If this is the case, direction of air flow can normally be assumed correct.

6. Check the instrumentation; verify no damage or loose connections.

7. Set the desired Productsaver limits.

8. Select a relatively high set point on the applicable instrumentation. The set point must be high enough that there will be a demand for heat.

9. Turn the HEAT switch ON.

A. With an amprobe, check heater current. (Check all 3 legs.)

10. Select a low set point on the applicable instrumentation. The set point must be low enough that there will be a demand for cooling.

11. Adjust the LN_2 circuit interrupter for the desired LN_2 control.

12. Turn the COOL switch ON.

13. Verify that the LN_2 circuit interrupter is providing proper LN_2 control.

14. Operate the system at the maximum conditions for which the system is designed, per the data summary sheet and Section 6. Verify that the chamber will meet all of the necessary conditions. During this procedure, DO NOT install the products to be tested.

COOLING

AUXILIARY LN_2 COOLING:

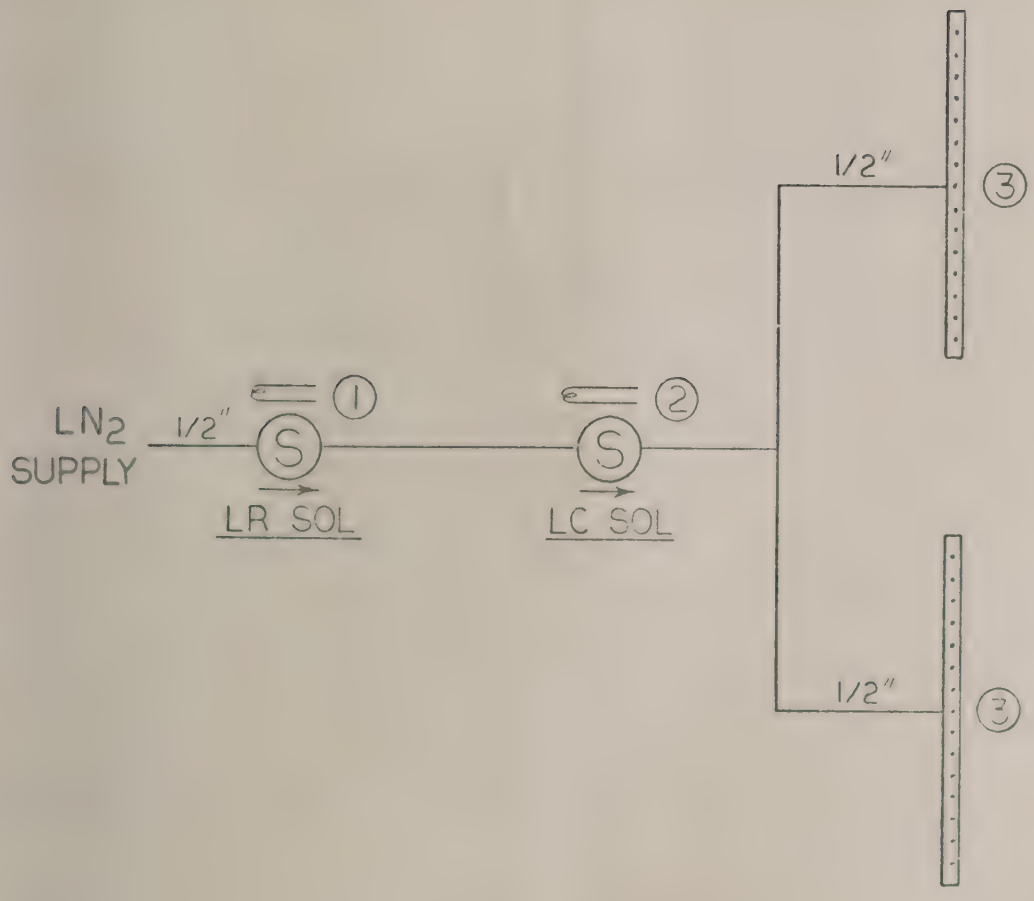
The auxiliary cooling on this chamber is accomplished by the injection of LN_2 into the conditioning plenum of the chamber.

The LN_2 injection is controlled by the action of the controlling instrument. The controlling instrument energizes the LN_2 solenoid through a delay timer and/or a thermal inturrupter.

Connect a clean, dry supply of LN_2 at 30 P.S.I. to the inlet side of the LN_2 control solenoid valve. (Insulate the piping from the supply to the chamber LN_2 valve.)

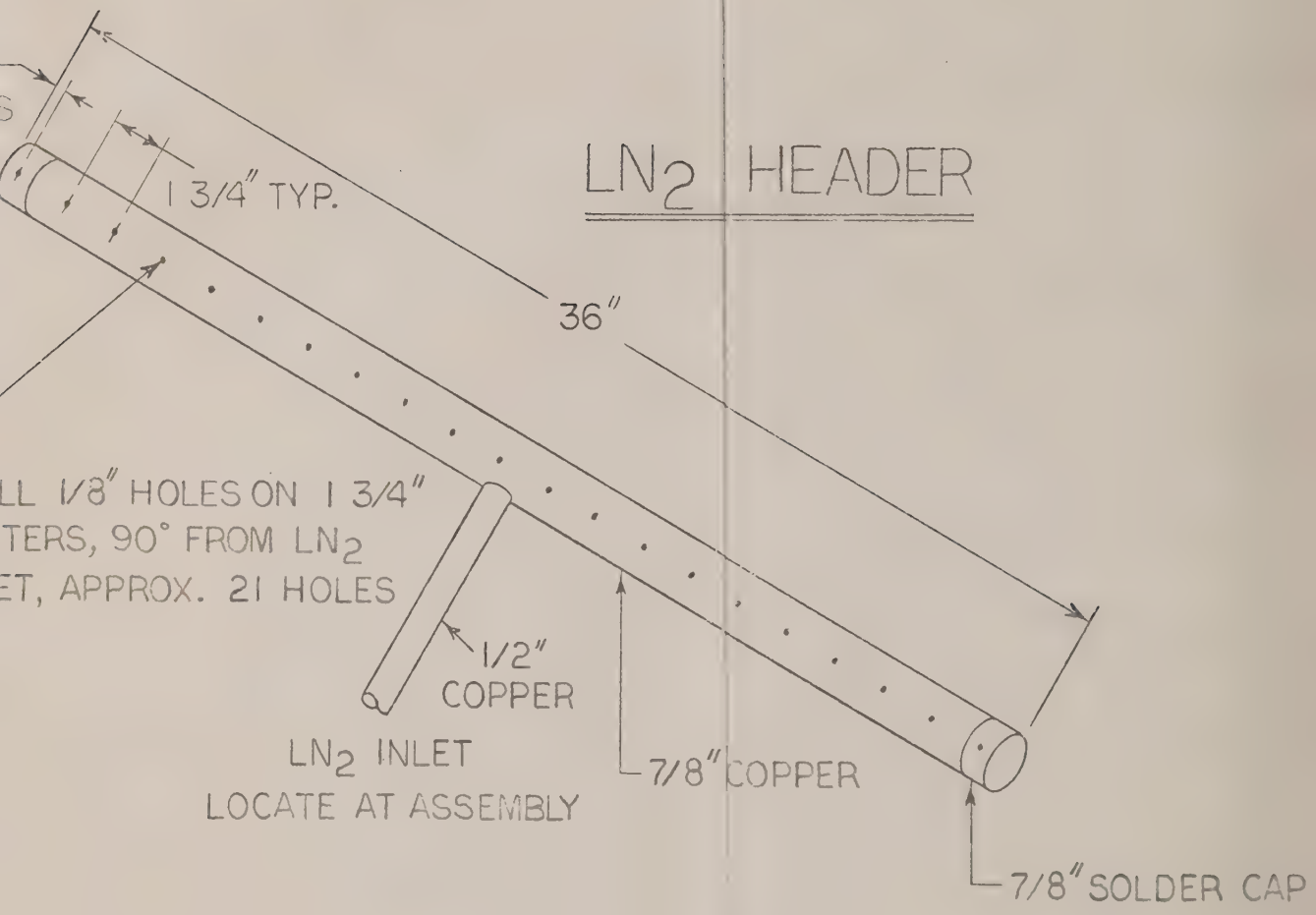
NOTE: A high pressure relief valve should be connected to this line to relieve pressure if LN_2 is trapped in the line.

Connect an LN_2 vent exhaust line (of the same size diameter as vent) to the vent connection provided. The line should be as short as practical and with as few bends as possible, to prevent back pressure.



SYM	DATE	CHANGE
A		
B		

DRAWN BY	DATE	SCALE	APP
AF		—	



LN_2 HEADER

208/3/60

TELEDYNE SYSTEMS

SYM	DATE	CHANGE	BY	MATERIAL	THERMOTRON CORP. HOLLAND, MICHIGAN U.S.A.	
C						
D						
DESCRIPTION: LN2 SCHEMATIC & HEADER ASSEMBLY					FOR: F-42-CHV	DRAWING NO.: LN2-22-9255 Y

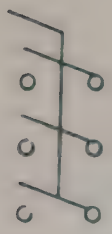
THERMOTRON CORPORATION

F 12-9253 Model F-42-CHV-LN_2 Voltage 208/3/60 Sheet 1 of 1 REF

OPTION LN_2 ASSEMBLY REFRIGERATION B/M

ITEM	SYMBOL	DESCRIPTION	MFG	PART NO	THERM NO	QTY	R/M
1	LP SOL	LN_2 REDUNDANT SOLENOID	ASCO	HT-8263-A210LT	549220	1	
2	LC SOL	LN_2 CONTROL SOLENOID	ASCO	8263-B206-LT	549212	1	
3		LN_2 HEADERS	THERMOTRON	REF DWG LN_2 9255		2	

ELECTRICAL SCHEMATIC SYMBOLS

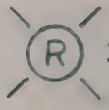

Disconnect Switch

Fuse

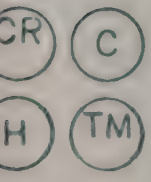
Heat Link

Heater

Chamber Interior Light



Panel Function Light

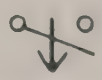


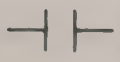
Energizing Coil (Contactor, Timer, Relay, etc.)

ON Delay Timer Contact (Timed to close)

ON Delay Timer Contact (Timed to open)

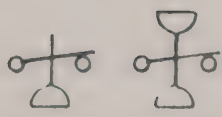
OFF Delay Timer Contact (Timed to close)

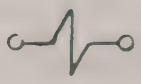

OFF Delay Timer Contact (Timed to open)


Normally Open Contact

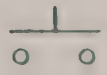
Normally Closed Contact

Thermal Actuated Switch (Heat & Cooling Limits, etc.


Pressure Actuated Switch


Refrigeration Solenoid

Switch


Pushbutton Switch

ELECTRICAL

LINE NUMBERS

The column of numbers running vertically to the left of the circuitry are the line numbers. They identify the corresponding horizontal lines in the circuitry.

CONTACT LINE NUMBERS

The numbers to the right of the circuitry are used to locate the contacts of a component part. For example, the numbers 12 and 18 after a line on which (CR 1) is placed would indicate that (CR 1) has contacts on lines 12 and 18.

Variations of contact line numbers are as follows:

18 - Contact is located on line 18 and is wired normally open.

<u>18</u> - Contact is located on line 18 and is wired normally closed.

18TC - Contact is located on line 18 and is timed to close.

18TO - Contact is located on line 18 and is timed to open.

P - Contact is located in the power section.

COMPONENT LOCATION

The following procedure may assist you in physically locating component parts. Note the abbreviation of the component part which appears on one of the electrical schematics. Locate that abbreviation on the electrical parts list, in the column directly to the left of the part description. Note the description for the correct nomenclature of the part. Then check at the top of that particular page of the parts list, after the heading ASSEMBLY, to find out the general area of the chamber in which this part is located.

NOTE: All components appearing on the electrical schematics are shown in the de-energized state.

ELECTRICAL

HIGH HEAT LIMITS:

The high heat limit is the prime prctective device in the heating system on this chamber. It is, therefore, extremely important that it is properly adjusted and tested.

HEAT LIMIT ADJUSTMENT:

The heat limit is factory adjusted.to open when the chamber temperature is approximately +375°F (+190.5°C).

The heat limit is a manual reset type. Once the setting has been exceeded, the reset button must be manually depressed.

PERIODIC CHECKS:

It is a good practice to check the heat limit when the opportunity presents itself. For example, if you have been working on the instruments, set the set point of the controller above the setting of the heat limit, and allow the chamber temperature to rise. The heat limit should open. (Push the manual reset button.) This check takes only a few minutes.

NOTE

The high heat limit is installed to protect the chamber from exceeding its limits. It is not intended for customer product protection.

ELECTRICAL

HUMIDITY-HEAT LIMIT ADJUSTMENT: (Humidity chambers only) The humidity heat limit should be adjusted to open at approximately +240°F (116°C). This will cause the humidity heat circuit to open if the humidity heater is energized when there is no water in the vapor generator, thus protecting the heater against burnout.

RELAYS

Reference: Electrical Schematic

C — Circulator motor contactor.

Function: To apply power to circulation motor and to interlock the heating and cooling circuits to the circulator switch.

H1 & H2 — Low heat contactors.

Function: Low heat for control provides for reduced wattage from the heating circuit.

H3 — High heat contactor.

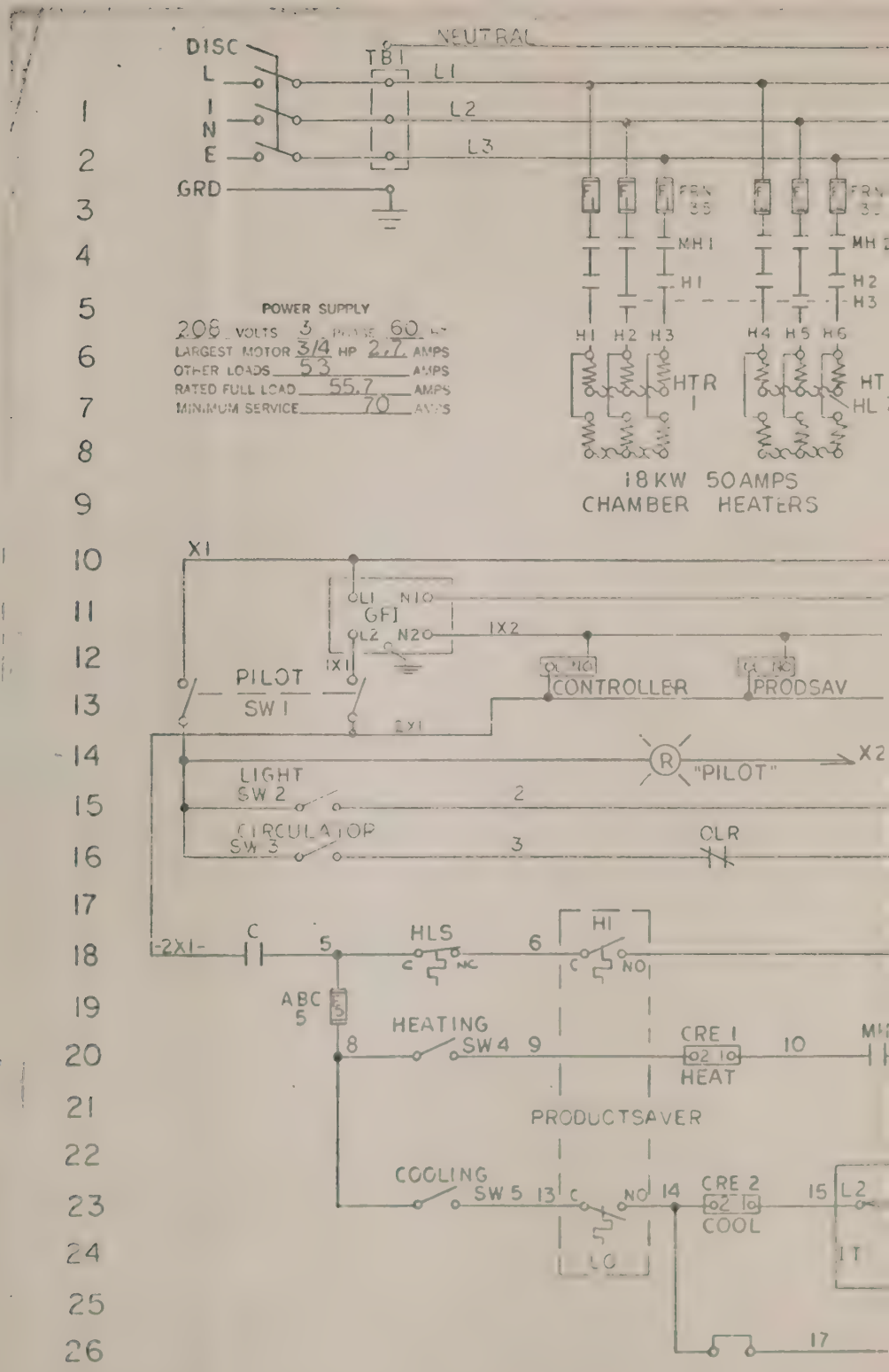
Function: High heat for fast temperature change. Provides for maximum wattage from the heating circuit.

MH1 & MH2 — Master heat contactors.

Function: Heater safety contactors to de-energize with heat limit devices. MH1 and MH2 do not cycle with heat demand.

TM1 — High heat delay timer.

Function: To delay energizing the high heat contactor.



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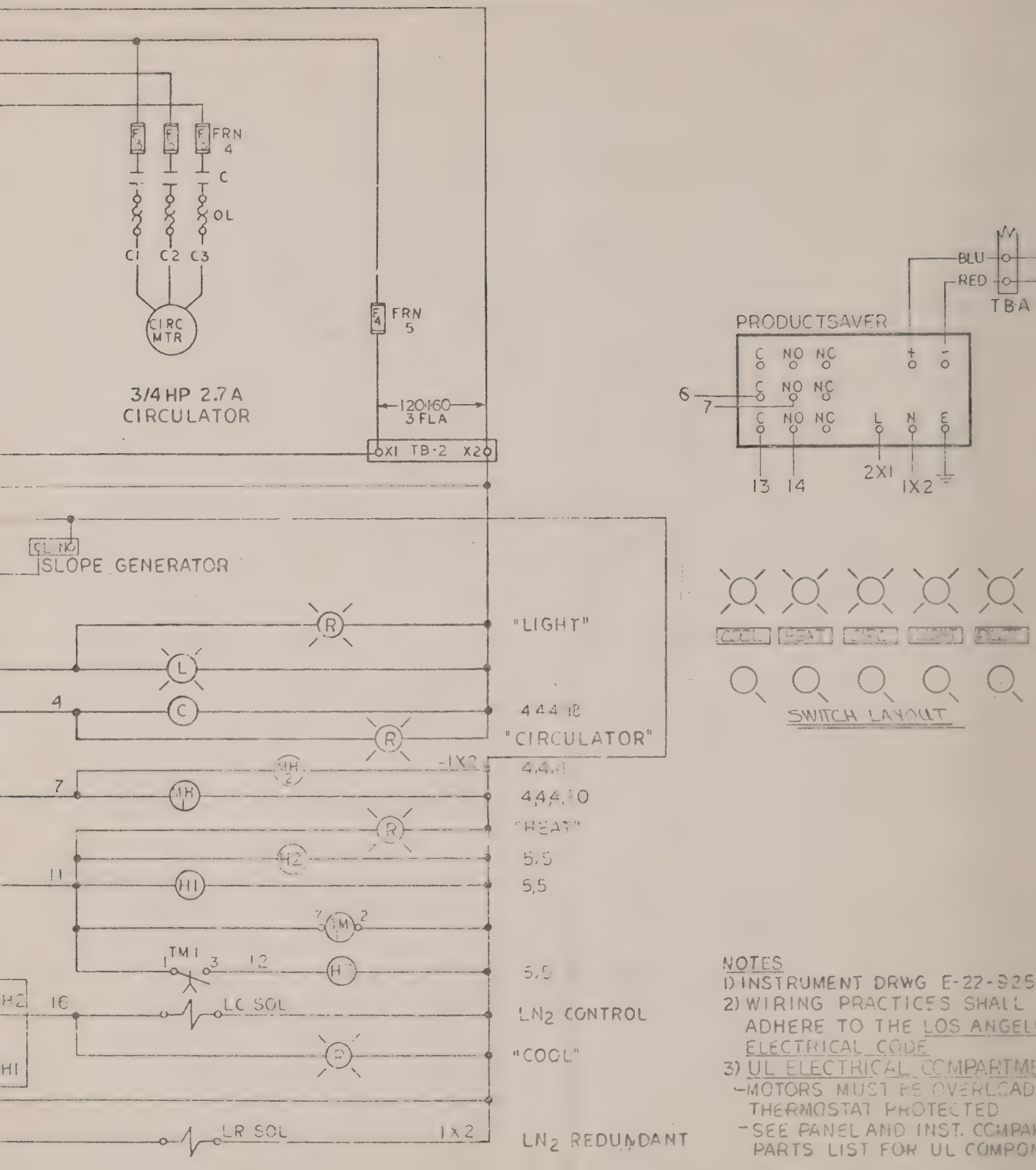
HOLLAND, MICHIGAN 49423



NOTES

1) INSTRUMENT DRWG E-22-9255-2-
2) WIRING PRACTICES SHALL ADHERE TO THE LOS ANGELES ELECTRICAL CODE
3) UL ELECTRICAL COMPARTMENT
- MOTORS MUST BE OVERLOAD OR THERMOSTAT PROTECTED
- SEE PANEL AND INST. COMPARTMENT PARTS LIST FOR UL COMPONENT

SCALE	ELECTRICAL SCHEMATIC
MATERIAL	F-42-CHV-LN_2
FINISH	JOB 22-9255
CHECKED BY	E-22-9255-1- X

NOTE:

REPLACE SLOPE GENERATOR INDICATOR METER #123 WITH #013005 INDICATOR / SET POINT METER

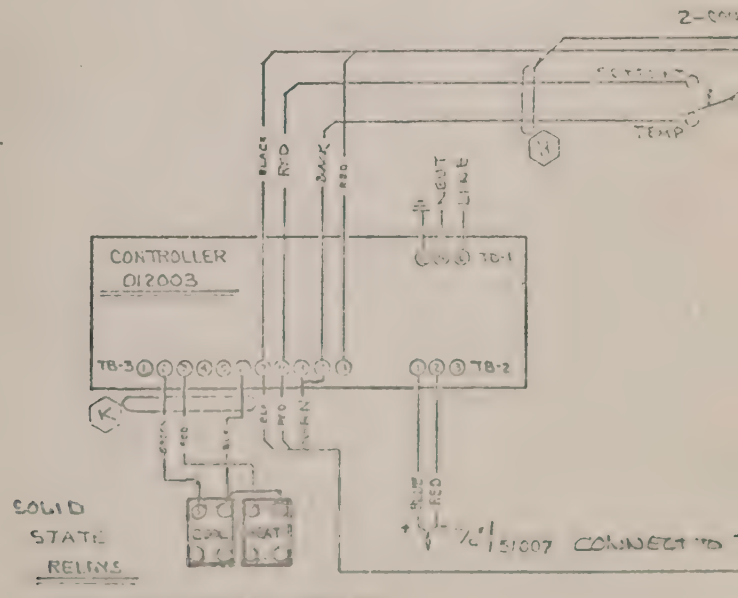
CAUTION: -

1. THE TWO WHITE WIRES WHICH ARE DISCONNECTED FROM THE #123004 METER MOVEMENT MUST BE INDIVIDUALLY TAPED TO PREVENT SHORTING.

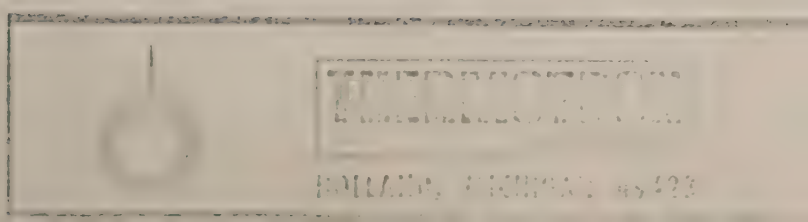
(*) TELEDYNE MULTI-CONDUCTOR CABLE -105

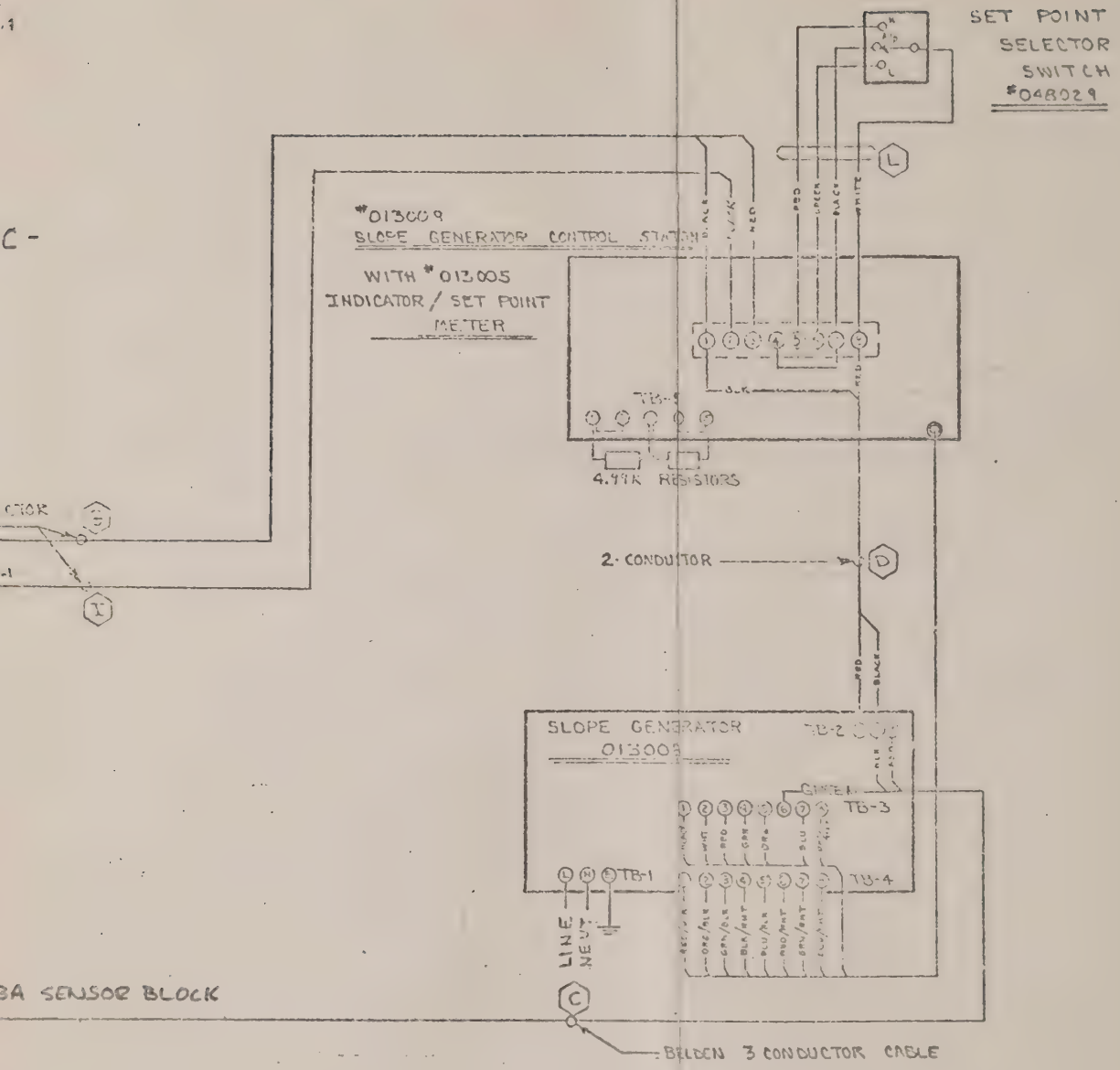
C	3-CONDUCTOR
D, G TO I	2-CONDUCTOR
K & L	4-CONDUCTOR

UL LISTED INSTRUMENT COMPARTMENT
- SEE INST. COMP. PARTS LIST FOR UL PARTS
- USE INST. CABLE RATED FOR 105° C



MOUNT ON RELAY BOARD
J-2072-1-4-Y




SET POINT SELECTOR SWITCH #048029
#013009
SLOPE GENERATOR CONTROL STATION
WITH #013005 INDICATOR / SET POINT METER
TB-5
4.99K RESISTORS
2-CONDUCTOR
SLOPE GENERATOR 013009
TB-2
TB-3
TB-4
TB-1
LINE
NEUT
BELDEN 3 CONDUCTOR CABLE

THERMOTRON CORPORATION

Job 22-9255 Model F-42-CHV-LN_2 Voltage 208/3/60 Sheet 1 of 3 ELECT

ELECTRICAL ASSEMBLY PANEL B/M

SYMBOL	DESCRIPTION	MFG	PART NO	THERM NO	QTY	R/M
DISC	DISCONNECT SWITCH 100A	G E	TED134Y100	568675	1	
OM	OPERATING MECHANISM	G E	TEFOM2	568691	1	
TB 1	POWER DISTRIBUTION BLOCK	MARATHON	1423570	571110	1	
TB 2	POWER PANEL TERMINALS	SQUARE D	9080KCA1	565412	20	
TB KIT	TERMINAL END KIT	SQUARE D	9080K1	590355	1	
F 1,F 2	HEATER FUSES	BUSS	FRN 35	576287	6	
F 3	CIRCULATOR FUSES	BUSS	FRN 4	576201	3	
F 4	CONTROL CIRCUIT FUSES	BUSS	FRN 5	576228	1	
FUSE BLK	FUSE BLOCK 250V	MARATHON	F30A3SP	553295	3	
FUSE BLK	FUSE BLOCK 1P 30A 250V	MARATHON	F30A1SP	553155	1	
MH 1,C	POWER CONTACTOR 4P 30A	FURNAS	42BE25AF	570874	2	
MH 2	POWER CONTACTOR 3P 30A	FURNAS	42BE35AF	500096	1	
H 1,H 2,H 3	MERCURY CONTACTOR 2P 35A	MDI	235NO-120A	571234	3	
TM 1	TIME DELAY RELAY .3 TO 10 SEC	ATC	319BOO3Q1C	563169	1	
SOCKET	RELAY SOCKET OCTAL PIN	CURTIS	RS8-SC	567814	1	
OLR	OVERLOAD RELAY STATION	A B	815BOV-16	557738	1	
OL	OVERLOAD HEATERS	A B	N-18	559811	3	
*HANDLE	DISC HANDLE SWITCH	G E	TH 1	568683	1	

*MOUNT ON ELECTRICAL COMPARTMENT

THERMOTRON CORPORATION

Job 22-9255 Model F-42-CHV-LN$_2$ Voltage 208/3/60 Sheet 2 of 3 ELECT

QUOTATION ELECTRICAL ASSEMBLY CHAMBER B/M

SYMBOL	DESCRIPTION	MFG	PART NO	THERM NO	QTY	R/M
HTR 1,2	CHAMBER HEATERS 9KW @208V	THERMOTRON	EL1134-26	545320	2	
EL	HEATER HEAT LINK 460°F	BUSS	WUY	534010	8	
HLS	HI HEAT LIMIT SWITCH	U E	F54G-12277	533723	1	
TB-A	SENSOR TERMINAL BLOCK	CURTIS	E-4	553074	1	
T/C 1	CONTROLLER THERMOCOUPLE	THERMOTRON	151007	151007	1	
T/C 2	PRODUCTSAVER THERMOCOUPLE	THERMOTRON	151008	151008	1	
L	CHAMBER LIGHT BULB	SYLVANIA	75PAR38	556308	1	
SOCKET	CHAMBER LIGHT SOCKET	PAULDING	50721BR	564459	1	

THERMOTRON CORPORATION

Job 22-9255 Model F-42-CHV-LN2 Voltage 208/3/60 Sheet 3 of 3 ELEC

OPERATION ELECTRICAL ASSEMBLY CONSOLE B/M

SYMBOL	DESCRPTION	MFG	PART NO	THERM NO	QTY	R/M
CONT	CONTROLLER	THERMOTRON	012003	012003	1	
IND/SET PT ASS'Y	INDICATOR SET POINT ASSEMBLY	THERMTORON	013005	013005	1	
S. GEN	SLOPE GENERATOR	THERMOTRON	013008/9	013008/9	1	EA
PROD SAV	PRODUCTSAVER	THERMOTRON	012005	012005	1	
SWITCH	S.P. SELECTOR SWITCH	THERMOTRON	048029	048029	1	
TEMP/SP SW	TEMP/SET POINT SWITCH	ALCO	555204	555204	1	
SW 1	TOGGLE SWITCH DPST	C H	7560K5	565773	1	
SW 2-5	TOGGLE SWITCH SPST	C H	7500K14	565765	4	
R	NEON PILOT LIGHT	IND DEV	1050QA1	566109	5	
CRE 1,2	SOLID STATE RELAY	CRYDOM	D2410	555735	2	
BOARD	RELAY MOUNTING BOARD	THERMOTRON	I-2072-1-4	528120	1	
CB	CIRCUIT INTERRUPTER	ROBERT SHAW	INF-120-8B	564785	1	
GFI	GROUND FAULT INTERRUPTER	SQUARE D	GFSR -115	558254	1	
BOX	HANDY BOX	APPLETON	4CS-1/2	561700	1	
COVER	GFI COVER	APPLETON	2510	553538	1	
FA	FUSE	BUSS	ABC-5	544504	1	
HLDR	FUSE HOLDER	BUSS	HKP	544563	1	

WARNING-Use Of The Following Components Is Dependant Upon The Additional Protection Afforded By The Gound Fault Circuit Interrupter And The Overcurre Protective Device Provided. DO NOT Remove Or Defeat These Protective Device

COMPONENT	IDENTIFICATION
CONTROLLER	012003
INDICATOR SET POINT ASSEMBLY	013005
SLOPE GENERATOR	013008/9
PRODUCTSAVER	012005
CIRCUIT INTERRUPTER	INF-120-8B

JOB-22-9255

PROTECTIVE OR SAFETY DEVICES

These are the protective or safety devices included in your system. Their general description and functions appear on pages 5.5.1 through 5.5.5 of this manual. Those items marked by an "X" on this sheet will identify the devices incorporated in your system and the factory settings will be specified (if applicable). For more in depth study, refer to the included component literature.

ITEM USED	QTY	ITEM	SETTING
( )	( )	Dual Function Hi-Low Pressure Switch	Open High Range 275 P.S.I.G. Open Low Range 5 "Hg.
( )	( )	Dual Function Hi-Low Pressure Switch	Open High Range 275 P.S.I.G. Open Low Range 0 P.S.I.G.
( )	( )	Pump Down Pressure Switch	Opens at P.S.I.G. Closes at P.S.I.G.
( )	( )	Hi-Pressure Dump Valve	Opens at 235 P.S.I.G.
( )	( )	Hi-Pressure Switch	Opens at P.S.I.G.
( )	( )	Low Pressure Switch	Opens at P.S.I.G.
( )	( )	Oil Pressure Differential Switch	Opens with Difference P.S.I.G.
( )	( )	Relief Valve	Relieves at 320 P.S.I.G.
( )	( )	Relief Valve	Relieves at P.S.I.G.
( )	( )	Altitude/Heater Interlock	Opens at Feet
( )	( )	Altitude/Temperature Interlock	Opens at Feet
( )	( )	Compressor Crankcase Heater	

PROTECTIVE OR SAFETY DEVICES (Continued)

ITEM USED	QTY	ITEM	SETTING
( )	( )	Compressor Discharge Gas Temperature Limit	Opens at 116°C 240°F
( )	( )	Door Limit Switch	
( )	( )	Low Limit Switch	Opens at °C °F
(X)	(1)	Heat Limit Switch	Opens at 190.5°C 375 °F
( )	( )	Heat Limit Switch	Opens at °C °F
(X)	(8)	Heat Link	Fuses at 238 °C 460 °F
( )	( )	Heat Link	Fuses at °C °F
( )	( )	Humidity Heat Limit Switch	Opens at 116°C 240°F
( )	( )	Malfunction Relay	
(X)	(2)	Master Heat Contactor	
( )	( )	Master Humidity Contactor	
(X)	(1)	Overload Protectors	
( )	( )	Photohelic Air Flow Gage	
(X)	(1)	Safety Interlock	
( )	( )	Condensate Heat Thermostat	Opens at 15.6°C 60°F
(X)	( )	Guards are provided for all air circulators.	
( )	( )	All Refrigerants used are non-toxic.	
(X)	( )	All Electrical Circuits are separately fused.	
(X)	( )	All Control Switches have indicator lights.	
(X)	( )	All Machinery is enclosed.	

NOTE: Several components included with this chamber are provided with additional protective devices. See the data summary sheets in this manual for details.

PROTECTIVE OR SAFETY DEVICES

The following are the protective or safety devices used in the refrigeration and electrical circuits (besides the branch circuit protections). Refer to electrical and refrigeration schematics and pages 5.1.0 and 5.2.0 for specific settings and for information as to which devices are included in your system.

NOTE: When working with any of the following devices which can be manually reset, do not reset more than twice in succession; The source of the tripping must be located.

DUAL FUNCTION HI-LOW PRESSURE SWITCH: (Located in the proximity of the compressors.)
The Hi-side of this switch is piped to sense the pressure of the discharge side of the refrigeration compressor, set to interrupt the control circuit of the compressor at abnormal pressure. The Lo-side of this switch is piped to sense the pressure of the suction side of the refrigeration compressor and to interrupt the compressor control circuit at abnormal pressure. (Manual Reset)

PUMP DOWN PRESSURE SWITCH: (Located in the proximity of the R-502 compressor.)
This switch prevents excessive refrigerant migration into the suction side of the R-502 compressor by energizing the compressor when the R-502 suction pressure rises to set limits. (Automatic Reset)

HI-PRESSURE DUMP VALVE: (Located adjacent to the R-13 vapor tank.)
The function of this valve is to prevent the high pressure of the low stage refrigeration system from rising above a set level. When the pressure exceeds this value, the valve opens and relieves this pressure to the vapor tank. The vapor is returned to the suction side of the compressor through the return line. This "dumping" process will continue until the pressure is no longer above tolerance. (Automatic Reset)

PROTECTIVE OR SAFETY DEVICES (Continued)

HI PRESSURE SWITCH: (Located in the proximity of the associated compressor.)
This switch is piped to sense the pressure of the discharge side of the refrigeration compressor. It is set to interrupt the control circuit of the compressor at abnormal pressure. (Manual Reset)

LOW PRESSURE SWITCH: (Located in the proximity of the associated compressor.)
This switch is piped to sense the pressure of the suction side of the refrigeration compressor. It is set to interrupt the control circuit of the compressor if the pressure remains below tolerance after a 60 second delay. (Manual Reset)

OIL PRESSURE DIFFERENTIAL SWITCH: (Located in the proximity of the associated compressor.)
Located to sense the oil pressure and suction pressure of the compressor. This switch is designed to open the electrical control circuit of the compressor at a set difference, to protect the compressor against oil pressure failure. (Manual Reset)

RELIEF VALVE:
Located in the high pressure piping of the refrigeration system to protect the system against excessive pressure. Refrigerant is expelled from the system when the pressure exceeds the relief valve limits.

ALTITUDE/HEAT INTERLOCK: (Located on the back side of the electrical compartment.)
A pressure switch designed to provide reduced heater wattage above a set altitude.

PROTECTIVE OR SAFETY DEVICES (Continued)

ALTITUDE/TEMPERATURE INTERLOCK: (Located on the back side of the electrical compartment.)
A pressure switch designed to open the heating and/or cooling control circuitry above a set altitude.

COMPRESSOR CRANKCASE HEATER:
Located in the bottom of the refrigeration compressor crankcase to prevent any liquid refrigerant from collecting in the oil. Refer to Electrical Schematic and note that the crankcase heater is not in the pilot circuit.

COMPRESSOR DISCHARGE GAS TEMPERATURE LIMIT: (Located in the proximity of the associated compressor.)
Factory adjusted to interrupt the control circuit of the compressor if the discharge gas temperature exceeds set limit. This will occur only at abnormal conditions. (Manually Reset)

DOOR LIMIT SWITCH: (Located adjacent to door so that it can stop door motion.)
Interlocked with the control circuit. The door(s) must be closed to operate the chamber.

LOW LIMIT SWITCH:
This is wired in series with the auxiliary cooling control circuit to open the circuit in the event the chamber falls below the lowest designed temperature.

HEAT LIMIT SWITCH:
This is wired in series with the heating control circuit to open the circuit in the event the chamber exceeds the highest designed temperature limit. (Adjustable; Manual Reset)

PROTECTIVE OR SAFETY DEVICES (Continued)

HEAT LINK: (Located on the chamber heaters.)
Wired in series with the heater to open the circuit in the event the chamber exceeds designed temperature limits. This control will fuse open when the heater frame temperature reaches set limits. (Not Resettable; Replace)

HUMIDITY HEAT LIMIT SWITCH: (Located on the humidity vapor generator.)
Wired in series with the humidity heating control circuit to open the circuit to protect the vapor generator from exceeding designed temperature limits. (Adjustable; Manual Reset)

MALFUNCTION RELAY: (Located in the chamber electrical compartment.)
Located and wired in series with all safety devices in the compressor control circuit. If the control circuit is interrupted, the relay will de-energize and the alarm light will indicate a malfunction. (Manual Reset)

MASTER HEAT CONTACTOR: (Located in the electrical compartment.)
This contactor is wired in series with the heat control contactors. Its function is to provide more positive protection against over-temperature of the chamber.

NOTE: This contactor does not cycle with heat demand as do the heat contactors.
It will cycle on and off only with the high temperature limit devices thereby providing protection against burned closed contacts.

PROTECTIVE OR SAFETY DEVICES (Continued)

MASTER HUMIDITY CONTACTOR:

The function of this contactor is identical to that of the Master Heat Contactor except it provides over temperature protection for the humidity generator(s).

OVERLOAD PROTECTORS: (Located in the electrical compartment when not actually a part of the protected motor.)
These protectors are set to open the circuit of the associated motor within safe limits.

PHOTOHELIC AIR FLOW GAGE: (Refer to assembly drawing for location.)
This device monitors the air flow and has individually adjustable high and low air flow limits.

SAFETY INTERLOCK: (Located in the chamber electrical compartment.)
The circulator switch is interlocked with the control circuit. The control circuit cannot be energized until the circulator switch is on.

CONDENSATE HEAT THERMOSTAT: (Located above the electrical compartment.)
When the chamber temperature rises to set limits, all condensate heaters will be disabled. (Adjustable, Automatic Reset)

OPERATING INSTRUCTIONS

These operating instructions will assist the operator in placing the chamber in operation. A thorough study of the electrical schematics and operating instructions of each control component must also be made to become proficient in operating this equipment.

The chamber is equipped with a temperature indicator/set point assembly which has two manually adjustable set points which are independent of each other. These set points are adjustable by use of the knobs on the indicator/set point assembly.

The chamber is capable of manual operation only. Therefore, only one set point is required. Either of two set point controls may be used since both are capable throughout the entire range of the chamber. When selecting the right-hand set point control, the set point selector switch must be in the "H" (high) position. When selecting the left-hand set point control, the set point selector switch must be in the "L" (low) position. The A/P (ambient/programming) position is to be used for selecting the ambient set point. The ambient set point may be set on a precision potentiometer located on the back of the meter case.

MANUAL OPERATION:

1. Turn the SET POINT SELECTOR switch to either the HIGH or LOW position.
2. Select the corresponding temperature set point on the chamber temperature indicator/set point assembly.
3. Turn the PILOT switch ON.

OPERATING INSTRUCTIONS

MANUAL OPERATION: (Continued)

4. Prepare the Slope Generator for the desired rate of slope, according to the Slope Generator manual.
5. Turn the CIRCULATOR switch ON.
6. Adjust the LN_2 circuit interrupter for the desired LN_2 control.
7. Turn the COOL switch ON.
8. Turn the HEAT switch ON.

NOTE: The non-selected set point control should be adjusted to the extreme high or low limit, as applicable, so that it does not cause interference with the selected set point control.

SET POINT/TEMPERATURE SWITCH:

When this switch is in the TEMPERATURE position, the actual chamber temperature will be indicated by the indicating pen in the meter. When this switch is held in the SET POINT position, the indicating pen in the meter will indicate the set point which is currently in effect.

PREVENTIVE MAINTENANCE ROUTINE DESCRIPTIONS

In the day-to-day operation of this equipment, you will become aware of certain levels of noise, vibration, temperature and pressure.

If you encounter any significant changes in these levels, investigate them immediately.

You should also develop a preventive maintenance program for this equipment.

To assist in the construction of this program, Thermotron has prepared the following list of preventive maintenance routines. All of the following should be performed MONTHLY.

1. CIRCULATOR MOTOR:

   On conventional chambers, check the rotation of the fan. (See Page 1.3.1.) Check the fan for tightness on the motor shaft.

2. ELECTRICAL PANEL:

   Check for components and wires that may vibrate loose during operation. Check for signs of contactor or relay arcing. Check to see the power and ground connections remain secure.

3. OPERATING CURRENTS:

   With an amprobe, check the operating current of the heaters, circulators and other components. These values are shown on the electrical schematic.

This program will add significantly to the life of the equipment and will keep the unscheduled down time on the equipment at an absolute minimum.

THERMOTRON CORPORATION

Holland, Michigan

PRODUCT SUPPORT

EQUIPMENT MAINTENANCE CONTRACT

Date _____

Purchaser:

_____ Model No. _____

_____ Serial No. _____

_____ P. O. # _____

Thermotron Corporation guarantees the service and materials under this contract which are in accordance with Thermotron Corporation specifications, if any part of said Thermotron services or material used by Thermotron Corporation as determined by the Service Engineer is defective in workmanship or material and not subject to misuse or abuse.

(A) Within thirty (30) days from date of installations, Thermotron Corporation will exchange and install a replacement part in place and instead of the said defective part without charge;

(B) Within a period beginning with the expiration of the above mentioned period and ending ninety (90) days from date of installation, Thermotron Corporation will furnish an exchange part for the defective one f.o.b. plant, Holland, Michigan, and installation and cost of installation thereof will be the responsibility of the customer;

(C) Exceptions: Thermotron Corporation shall guarantee to the extent of the original supplier warranty. On items such as expansion valves, relays, thermostats, limit controls, motors, receivers, vapor tanks, condensers, gauges, transformers, heaters, and compressors, the warranty is one year from date of installation;

(D) Thermotron Corporation will not honor warranties on such items as freons (502, 13, 22, 12) or any other type used as a refrigerant.

1. Furnish all labor, material, tools, and equipment required to service and maintain environmental test equipment, as set forth below, during the period commencing _____ and ending _____ on the terms and conditions set forth herein.

2. Service rendered hereunder shall cover normal maintenance such as, but not necessarily limited to, inspection and adjustment.

3. A total of _____ scheduled calls shall be made as follows:

   _____ - Normal maintenance

   _____ - Normal maintenance

   _____ - Normal maintenance

   _____ - Normal maintenance

4. Emergency service calls shall be made on an "as needed" basis as requested by _____ and at the regular rates indicated elsewhere herein.

5. Only trained personnel qualified in maintenance and repair shall service this equipment.

6. Detailed maintenance reports shall be filed in triplicate with the _____ representative for maintenance service call. The report shall be in the form of a detailed list, signed and certified by the Thermotron Service Engineer responsible for the service rendered.

7. When receiving the report based upon Thermotron's Service Engineer's evaluation, and if items are to be replaced, it will be negotiated in a time/material contract covered by a separate purchase order number.

8. Replacement parts furnished by Thermotron will be billed at current retail prices. _____ may furnish the required replacement parts if desired.*

* Parts furnished by _____ will be evaluated and approved for use by Thermotron Service Engineer before installation.

9. Each chamber qualifying after each checkout shall receive a label stating date of next inspection, and shall be signed by the Thermotron Service Engineer making the call.

10. Charges for services rendered under this agreement shall be computed at the following rates, except as noted below:

a. Labor: Monday through Friday @ $_____per hour.
Saturdays, Sundays, holidays, and hours in excess of 8 on weekdays @ $_____per hour.
Travel time @ $_____per hour.

b. Transportation: Surface @ $_____ per mile and tolls.

Air - Actual cost of tourist class fare except those flights with one-class fare.

Other - At actual cost.

c. Per Diem: Room - Actual cost.
Food - $_____ per day.

NOTE: In the case of work performed by independent authorized subcontractors of Thermotron, per diem is not an allowable item of cost.

11. Invoices shall be rendered in triplicate and shall reference this Agreement Number_____and shall be detailed in such a manner as to reflect the cost of servicing each of the chambers with subtotals shown for Group No. 1 and Group No. 2 with 50% of the total cost for travel and subsistence applied to each group.

Invoices, with supporting data, shall be forwarded to:

_____

_____

_____

_____

12. In providing the described normal maintenance and emergency services, it is anticipated that Thermotron Corporation will provide a factory service engineer for the routine services. It is also agreed that Thermotron Corporation has the option of providing a local, authorized contractor for minor adjustments or emergency service, if that is in the best interests of expediting job operation continuity.

Thermotron Corporation shall not be liable under this service agreement or contract for any operational delays or consequential damages, and the customer assumes all risk and liability whatsoever resulting from the use of such equipment and materials.

This service contract cannot be modified in any way except by a written instrument duly executed by Thermotron Corporation and the customer.

Date_____ Yearly Total_____

Accepted and Approved By:
(Purchaser)

_____

_____
Title

Accepted and Approved By:
(Thermotron)

_____

_____
Title

100526